

REMARKS/ARGUMENTS

The title has been amended herein. In the specification, paragraph 1, page 2, lines 5 and 6 have been amended to include the issued patent number and date. No new matter has been added.

The Office Action mailed June 14, 2006 has been received and reviewed. Claims 10 through 31 are currently pending in the application. Claims 10 through 31 stand rejected. No claims are amended herein. Reconsideration is respectfully requested.

35 U.S.C. § 103(a) Obviousness Rejections

Obviousness Rejection Based on Applicant's Admitted Prior Art in view of Japanese Patent 05-041485 to Yamada Osamu

Claims 10 through 31 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Applicant's admitted prior art in view of Yamada Osamu (Japanese Patent 05-041484). Applicant respectfully traverses this rejection, as hereinafter set forth.

M.P.E.P. 706.02(j) sets forth the standard for a Section 103(a) rejection:

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, **the prior art reference (or references when combined) must teach or suggest all the claim limitations.** The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). (Emphasis added).

Osamu discloses a method of improving reliability of a MOS semiconductor element. The method includes covering a substrate surface (except a faulty unit element 15) with a protective film 9. (Osamu, Abstract). The silicon substrate is etched with phosphoric acid and nitric acid to remove the source electrode 7. (Osamu, paragraph [0012] "the acid and nitric acid etching reagent with which the ratio of phosphoric acid **and** a nitric acid . . .") (emphasis added). Then, the PSG film 51 on the gate electrode 6 is etched with HF buffer. An etchant comprising nitric acid, HF and acetic acid is used to remove the gate electrode 6 and form an opening 10. *Id.*

Applicant respectfully submits that the proposed combination of the Osamu and the prior art fail to teach or suggest every element of claim 10 of the presently claimed invention.

By way of contrast with Osamu, claim 10 of the presently claimed invention recites a “method of removing oxide polymer and metal polymer from a contact opening in a dielectric layer having an underlying metal-containing layer on a semiconductor substrate, the method comprising applying a solution consisting essentially of a nitric acid solution on the contact opening followed by a phosphoric acid solution dip.” Applicant respectfully submits that Suzuki fails to teach or suggest “removing oxide polymer and metal polymer from a contact opening in a dielectric layer having an underlying metal-containing layer on a semiconductor substrate, the method comprising applying a solution consisting essentially of a nitric acid solution on the contact opening followed by a phosphoric acid solution dip.”

Instead, Osamu fails to teach or suggest a nitric acid solution dip *followed by a phosphoric acid solution dip* as recited in claim 10. At best, Osamu teaches a first etchant containing both phosphoric acid and nitric acid followed by a nitric acid solution containing etchant which is not the method comprising “applying a solution consisting essentially of a nitric acid solution on the contact opening followed by a phosphoric acid solution dip” as recited in claim 10 of the presently claimed invention. (Osamu, paragraph [0012] “the acid and nitric acid etching reagent with which the ratio of phosphoric acid **and** a nitric acid”)(emphasis added). Similarly, the prior art only teaches a phosphoric acid dip and fails to teach or suggest applying a solution consisting essentially of a nitric acid solution on the contact opening followed by a phosphoric acid solution dip.

Even assuming the combination of the prior art and Osamu teaches or suggests nitric acid solutions and phosphoric acid solutions as etchants, which applicant does not concede, nothing in the cited combination of art teaches or suggests the sequential application of “a solution consisting essentially of a nitric acid solution” “followed by a phosphoric acid solution dip” as recited in claim 10 of the presently claimed invention. Thus, the combination of the prior art and Osamu fails to teach or suggest every element of the presently claimed invention. Accordingly, claim 10 is not rendered obvious by the art and is allowable.

Further, Osamu utilizes etchants to remove silicon layers and the gate electrode. No motivation exists within Osamu to utilize the etchant for any purpose other than to remove

silicon layers and the gate electrode. The admitted art lacks any teaching or suggestion of using nitric acid to remove residue in a contact opening to remove an oxide or metal polymer. Thus, no motivation exists in the prior art or Osamu for “applying a solution consisting essentially of a nitric acid solution” followed by a phosphoric acid dip on an already formed contact opening. Accordingly, Osamu in view of the admitted art cannot render claim 10 of the presently claimed invention obvious and claim 10 is allowable. Reconsideration and withdrawal of the rejection is requested.

Claims 11-20 are each allowable as depending, either directly or indirectly, from allowable claim 10. Reconsideration and withdrawal of the rejection is requested.

Claims 18 -20 are further allowable as Osamu fails to teach or suggest that the phosphoric acid dip includes a fluoride-containing component, or that the fluoride-containing component includes hydrofluoric acid or ammonium fluoride. At best, Osamu discloses a separate HF etch or a second etch wherein the second nitric acid containing solution includes hydrofluoric acid. (Osamu, Abstract).

By way of contrast with Osamu, independent claim 21 of the presently claimed invention recites a “method of fabricating a via in a dielectric layer and an underlying barrier layer for a semiconductor device, comprising: forming a partial via in the dielectric layer to expose at least portion of the barrier layer; cleaning the partial via with a phosphoric acid-containing solution; etching the barrier layer after the cleaning to form a full via having a metal containing trace on a bottom surface thereof; and applying a nitric-acid containing solution to the full via.” Applicant respectfully submits that the proposed combination of Osamu and the prior art fails to teach or suggest every element of claim 21 of the presently claimed invention.

The proposed combination fails to teach or suggest “forming a partial via in the dielectric layer to expose at least portion of the barrier layer; cleaning the partial via with a phosphoric acid-containing solution.” The admitted art does not teach or suggest cleaning a partial via, but only that the full via may be cleaned with phosphoric acid. Specification, page 4, lines 10-15. Osamu lacks any teaching or suggestion that phosphoric acid may be used to clean a partial via exposing at least a portion of a barrier layer. Instead, Osamu discloses a solution containing both phosphoric acid and nitric acid to etch a substrate, not to clean an existing via. (Osamu, paragraph [0012] “the acid and nitric acid etching reagent with which the ratio of phosphoric acid

and a nitric acid") (emphasis added). Mixtures of phosphoric acid and nitric acid are insufficient to remove metal polymer. (Specification, page 8, lines 4-5).

Further, the proposed combination fails to teach or suggest "etching the barrier layer after the cleaning to form a full via having a metal containing trace on a bottom surface thereof, and applying a nitric-acid containing solution to the full via." Instead, Osamu fails to disclose any cleaning after forming opening 10 and discloses a nitric-acid containing solution to remove gate electrode 6. (Osamu, paragraph [0012]). The proposed combination lacks any teaching or suggestion of applying a phosphoric acid containing solution to a partial via, etching the partial via to form a full via and applying a nitric acid containing solution to the full via. No motivation exists in either the prior art or Osamu applying a phosphoric acid containing solution to a partial via, etching the partial via to form a full via and applying a nitric acid containing solution to the formed, full via. Accordingly, Osamu and the prior art cannot render claim 21 of the presently claimed invention obvious and claim 21 is allowable. Reconsideration and withdrawal of the rejection is requested.

Claims 22-31 are each allowable as depending, either directly or indirectly, from allowable claim 21. Reconsideration and withdrawal of the rejection is requested.

Claims 29 -31 are further allowable as Osamu fails to teach or suggest that the *phosphoric acid dip* includes a fluoride-containing component, or that the fluoride-containing component includes hydrofluoric acid or ammonium fluoride. At best, Osamu discloses a separate HF etch or a second etch wherein the second nitric acid containing solution includes hydrofluoric acid. (Osamu, Abstract).

CONCLUSION

Claims 10 through 31 are believed to be in condition for allowance, and an early notice thereof is respectfully solicited. Should the Examiner determine that additional issues remain which might be resolved by a telephone conference, she is respectfully invited to contact Applicant's undersigned attorney.

Respectfully submitted,



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Date: August 2, 2006
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